

September 14, 2007

Stephen Johnson, P.E.
Delaware Department of Natural Resources and Environmental Control
Site Investigation and Restoration Branch
391 Lukens Drive
New Castle, DE 19720

RE: Remedial Action Work Plan Hercules Road Property (DE-1323) Wilmington, Delaware

File # 1938.03.21

Mr. Johnson:

As requested by DNREC-SIRB in correspondence dated July 13, 2007, BrightFields, Inc. (BrightFields), on behalf of our client Toll Brothers, Inc., (Toll Brothers) is pleased to provide you with a Remedial Action Work Plan (RAWP) for the Hercules Road Property (see Figure 1). This RAWP is intended to provide a narrative of how environmental conditions associated with the historic use of the property as a golf course will be remediated. The RAWP implements the scope of work set forth in the Final Remedial Action Plan advertised by DNREC-SIRB on July 18, 2007.

### Remedial Action Work Plan

The following remedial action tasks are presented in the approximate sequence in which they will be performed. The attached remediation timelines (Appendix A) provide detail for the task sequence order. In addition to the work scope outlined herein, the remedial work will be performed in accordance with a Health and Safety Plan, and contractors will be provided with appropriate specifications and training covering the environmental nature and contingencies associated with the project. BrightFields personnel will be on site during intrusive subsurface and soil handling activities to provide environmental health and safety oversight and guidance for on-site workers and monitor for conditions that could affect the surrounding environment



(e.g., nuisance dust monitoring). BrightFields will provide DNREC-SIRB with documentation on confirmatory sampling data, and post-remedial soil conditions.

### TASK 1 – Install Construction Entrance and Vehicle Washing Station

A construction entrance and separate truck washing area will be installed on site by the contractor as part of the required site stabilization depicted on the erosion and sediment control plan (E&S plan) Detail No. De-ESC-3.4.7, developed by Eastern States Engineering (ESE). The entrance will be created using stone as a ground cover which all construction vehicles will be required to use for access to the property. Soil on vehicle tires will be washed off before leaving the property to prevent material from being tracked off site.

### TASK 2 - Remove and Dispose of ACM Irrigation Pipe

Irrigation piping known to contain asbestos containing materials (ACM) will be removed from the subsurface. The location and depth of the underground piping is mostly unknown, therefore the removal will begin at the known locations and the removal process will follow the pipe as it is encountered. The process will involve trenching with a backhoe to locate and remove the pipes.

Due to the asbestos content identified in the pipe material, the removal will be performed by a licensed asbestos abatement contractor. BrightFields personnel licensed by the State of Delaware to perform Project Monitoring services will oversee the contractor during the removal to document compliance with applicable regulations and to monitor ambient conditions. The removed pipe will be wrapped and transported offsite for proper disposal. After the pipes are removed and trenches backfilled, the disturbed soil will be stabilized in accordance with Delaware Sediment and Stormwater Regulations.

### TASK 3 – Remediate Impacted Soil

Following removal of the irrigation piping the soil remediation tasks will begin. The remediation activities will begin with the excavation of the areas identified in Section 3.1 which have the highest concentrations of arsenic on the site and include mostly former greens and tees. Soil blending activities will occur in the areas identified in Section 3.2 (mostly fairways) and will be conducted, at times, simultaneously with the excavation activities. The soil remediation activities will occur on the property in four phases as outlined in the E&S plan (See Appendix



B). Following the soil remediation activities, the site work required for construction will take place.

BrightFields will perform oversight during the remedial activities outlined in Tasks 3.1 and 3.2. Oversight will include monitoring ambient air conditions for the presence of volatile organic compounds using a photo-ionization detector and also monitor dust conditions using hand-held monitors at the point of remediation. In addition to the hand-held dust meters fixed air monitoring devices will be set at the perimeter of the work zone and a weather station will be placed on site to record wind direction and other climatic conditions. The Health and Safety Plan discusses air monitoring action criteria and the perimeter dust monitoring program is provided in Appendix E.

BrightFields has developed soil remediation guidelines based upon the stated Remedial Action Objectives:

### 3.1 Offsite disposal of soil areas containing arsenic concentrations above 37 mg/kg

Soil identified during the Remedial Investigation containing arsenic concentrations greater than 37 mg/kg has been identified in the following locations, (see Figure 2):

- Green 1
- Green 2
- Green 3
- Green 4
- Green 5
- Green 8
- Green 9
- Practice Green 3
- Men's Tee, Hole 1
- Tee, Hole 2
- End, Fairway 8

The impacted soil in these locations will be excavated and loaded directly into trucks licensed to haul this material, and transported off site for disposal. Based on the sampling data reported in the RI/FS, the estimated depth of excavation in these areas is 1.5 feet below ground surface (bgs) to remove soil containing an arsenic concentration above 37 mg/kg. BrightFields will perform post excavation confirmatory sampling using x-ray fluorescence spectroscopy (XRF) technology to verify that remaining soils have



arsenic concentrations below 37 mg/kg. The XRF technology provides real time data in the field so that further excavation can be completed if necessary to achieve the target cleanup objectives. Additional confirmatory samples will be collected for laboratory analysis at Test America (a HSCA certified laboratory) for RCRA metals and target pesticides and herbicides. Appendix C contains documentation of the sampling design for the remediated areas.

Material removed from the site for disposal will go to a licensed facility with documentation on final quantities provided to Toll Brothers. BrightFields estimates that approximately 5,000 cubic yards of material will be generated from the areas listed above.

### 3.2 Blending of soil with arsenic concentrations between 11 mg/kg and 37 mg/kg

The RI/FS identified soil with arsenic concentrations between 11 mg/kg and 37 mg/kg in the following locations, (see Figure 2):

- Practice Green 1
- Fairway 1
- Fairway 3
- Fairways 4 (2 locations)
- Fairway 5
- Fairway 8
- Fairway 9
- Women's Tee, Hole 1
- Tee, Hole 3
- Tee, Hole 4 (2 locations)
- Tees, Hole 8 (2 locations)
- Tees, Hole 9 (3 locations)
- Area A (large section between fairway 3 and practice green 3)

The remedy selected for this soil calls for mechanically blending the soil with spading equipment resulting in lower overall concentrations of residual contaminants. Soil with arsenic concentrations above 11 mg/kg have been identified in the upper 12-inches of soil in the above locations. The blending operation is designed to mix shallow impacted soil with deeper un-impacted soil. The depth at which the equipment operates can be adjusted from 0 to 40 inches and will be adjusted as necessary throughout the operation,



and multiple passes can be made to mix soil in various depth combinations. The spading equipment will be trailed behind a tractor and is inside of a housing that reduces dust generation. Overall dust suppression will be achieved by wetting the ground surface ahead of, during, and behind operation of the spading equipment. BrightFields will be on site during the blending operation to provide environmental health and safety monitoring and guidance on remedy implementation.

The soil blending process will result in soil suitable for construction without environmental restrictions because the resulting concentrations will be less than the Remedial Action Objectives. This will be verified by BrightFields through confirmatory sampling (Appendix C) and XRF technology. The laboratory analytical results will be submitted to DNREC-SIRB as they are available throughout the remediation. Upon completion of the remediation, as determined by laboratory analytical results, sitework for construction will be initiated. A Remediation Completion Report will be provided to DNREC-SIRB when final laboratory data packages are available, as summarized in Task 6.

### TASK 4 - Remediate Impacted Sediment

The RI/FS indicates that there are approximately 120 cubic yards of sediment materials with elevated pesticide concentrations in an existing drainage depression. Based on concentrations of contaminants identified in the RI/FS the sediment will be transported off site for disposal as non-hazardous material as defined by Resource Conservation & Recovery Act (RCRA). Disposal characterization analysis will be performed prior to disposal. Sediment removal will be performed separate from the other remedial action tasks discussed in this RAWP. The sediments will be addressed in conjunction with the proposed stream stabilization work during the final stages of the redevelopment project under the jurisdiction and permit from DNREC Sediment and Stormwater Branch.

### TASK 5 - Conduct Post-Remediation Sampling

As discussed above, BrightFields will collect real time post-remedial confirmatory samples utilizing XRF technology to document that the remedial action objectives have been achieved by excavation and soil blending operations. In addition, BrightFields will collect additional confirmatory samples that will be submitted to a laboratory for analysis of post-remedial site conditions.



BrightFields will collect samples for laboratory analysis of the surface soils in areas that soil has been excavated or blended to document that these soils achieve the remedial action objectives and meet the DNREC-SIRB Unrestricted Use (residential) cleanup criteria. Fifty-nine soil samples will be obtained from the excavated areas. A minimum of 5 samples will be obtained from each individual excavation area. Four samples will be removed from the sidewalls of the excavations, one each from the north, east, south, and west directions; and one sample will be obtained from the base of the excavation. Two additional sidewall samples will be collected from the excavations at Green 8 and Practice Green 3 due to their larger area.

Eighty soil samples will be obtained from the blended areas. The number of samples was determined using the Singer and Wickman algorithm formula which indicated that at least sixty-four sample points are necessary. BrightFields increased the number of sampling locations to eighty to accommodate several sample grid layouts and increase coverage in targeted areas. Appendix C contains documentation of the sampling design for the blended areas.

The confirmatory samples will be submitted for laboratory analysis of the contaminants of concern identified in the RI/FS; which are arsenic, cadmium, lead, mercury, chlordane, heptachlor epoxide, aldrin, and dieldrin. Soil data from the remediation areas were used to determine the contaminants of concern at the site. All the soil data from the areas that are scheduled to be remediated that had been analyzed by an outside laboratory was examined to determine which analytes were present above the unrestricted use URS.

In addition, the 95% UCLs from this data set were entered into the DNREC Site-Specific Standard Calculator for multiple analytes. Those analytes that were found, based on this risk assessment, to exceed either a carcinogenic risk 10<sup>-6</sup> or a Hazard Index of 0.1 were retained. This distinction is based on criteria presented in the EPA guidance (USEPA, 2000) where contaminants of concern (COCs) can be eliminated based on a lack of risk. Contaminants that exceeded their specific URS but did not exceed the above listed risk factors were removed as potential COCs. The results showed that all the analytes that exceeded the unrestricted URS, except DDE, also were found to present a significant risk.

### TASK 6 – Remediation Completion Report

The remediation will be considered complete upon receipt of laboratory analytical data that documents that the soil conditions meet the Remedial Action Objectives stated in the Final Remedial Action Plan. This data will be provided to DNREC-SIRB throughout the remediation as it becomes available from the laboratory rather than waiting until the end of the project. This



will enable DNREC-SIRB to initiate the project review sooner in the project. Upon completion of the remediation BrightFields will prepare and submit to DNREC-SIRB a Remediation Completion Report that documents attainment of the Remedial Action Objectives. DNREC-SIRB will review the completion report as soon as the work and the report are completed and will provide documentation stating that the site is cleaned up to the technical and substantive standards of HSCA. DNREC-SIRB is to respond within 15 working days of the date that the report is submitted indicating approval that the Remedial Action Objectives have been met, or stating that additional remediation is necessary.

Submission of the Remediation Completion Report may come after initiation of the non-remedial construction sitework due to the time necessary to receive complete laboratory data packages which will be included in the Report. The first phase of construction does not include areas undergoing remediation, therefore in the unlikely event that laboratory QA/QC or data validation indicate further remediation is necessary, initiation of construction will not impede the performance of any additional remediation work.

The Remediation Completion Report will provide tabulations of off-site disposal activities with appropriate documentation, and a compilation of confirmatory sampling data from all post remedial sampling. This will be in addition to the air monitoring reports compiled daily during the remediation. BrightFields will provide the air monitoring reports to DNREC-SIRB during remediation activities and DNREC-SIRB will make the summary reports available to the public.

### TASK 7 – Post Closure Lot Sampling

Following the remediation the next phase of site development will be grading and earthwork leading to construction of the planned residential development. Once building permits have been issued by New Castle County Land Use, building lots have been surveyed and staked, and foundation work completed, BrightFields will collect samples of the surface soil from each individual lot for laboratory analysis to document that these soils achieve the Remedial Action Objectives stated in the July 2007 Final Remedial Action Plan. The individual lot samples will be collected as a five-point composite. Samples will be analyzed for arsenic, cadmium, lead, mercury, chlordane, heptachlor epoxide, aldrin, and dieldrin. Additional removal and/or blending of contaminated soils will be performed as needed if analysis indicates concentrations exceeding the Remedial Action Objectives. Following receipt of the analysis documenting that Remedial Action Objectives are achieved, construction may proceed and the surface of the site will be finished off by the placement of topsoil and landscaping. Topsoil will come from unimpacted portions of the site and will be tested for compounds of concern prior to reuse. Upon



receipt of these confirmatory sample results for individual building lots, BrightFields will issue a letter to DNREC-SIRB and a copy to New Castle County stating that the sample results for the lot do not exceed the concentration standards used as the Remedial Action Objectives stated in the Final Remedial Action Plan. An example of the letter is included in Appendix D. DNREC-SIRB will provide a written response within ten working days from the date of the letter concurring or disputing with BrightFields statement of compliance. Alternatively, after ten days BrightFields certification and sampling results will be forwarded to a pre-approved HSCA-certified consultant for review. Following the process established for the Construction Completion Report, the consultant will provide written notice to DNREC-SIRB, Toll Brothers, and the New Castle County Land Use Department that the confirmatory samples do or do not meet the Remedial Action Objectives. Notice that the Remedial Action Objectives have been achieved will enable the County to issue a certificate of occupancy for the subject residence.

### Notice on the Protection of Workers and the Public from Arsenic Inhalation

BrightFields has assessed that under the current circumstances at the Hercules Road Property site, the inorganic arsenic located in the soil remediation areas is not an inhalation threat to workers or the public as a result of volitization.

Research has shown that arsenic compounds are not expected to volatilize from moist soil surfaces. However, arsenic compounds in soil may be methylated by microorganisms and subsequently lost by volatilization. Biotransformation of arsenic can produce highly volatile compounds such as arsine (AsH<sub>3</sub>), dimethylarsine (Has(CH<sub>3</sub>)<sub>2</sub>) and trimethylarsine (As(CH<sub>3</sub>)3), although it would take extremely anoxic environments for production to take place. BrightFields does not expect extremely anoxic environments within the work area of the property.

To prevent worker and public inhalation of possible arsenic contaminated airborne dust, a dust suppression program (Appendix E) will be implemented for all site activities that create sustained airborne dust concentration in the breathing zone that exceed the action levels outlined in the Health and Safety Plan.

<sup>1 &</sup>quot;Arsenic Compounds" Hazardous Substances Data Bank. Last reviewed: 9/15/2001, U.S. National Library of Medicine, National Institutes of Health, Department of Health & Human Services, <a href="http://www.toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~nenKI8:2">http://www.toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~nenKI8:2</a>

<sup>&</sup>lt;sup>2</sup> Bodek, Ph.d., Itamar, Warren J. Lyman, Ph.D., William F. Reehl, and David H. Rosenblatt, Environmental Inorganic Chemistry, New York: Pergamon Press, 1988. chapters 7.25-7.26

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A minimal device will be used by the on-site Safety Officer to measure the levels of air borne dust particles. If airborne dust exceeds the action level, water controls will be used to wet the problem areas and reduce the airborne dust to safe levels.

If you have any questions regarding this Remedial Action Work Plan please contact Craig Olsen or myself at 302.656.9600.

Sincerely,

BrightFields, Inc.

J. Curtis Hatfield, P.E.

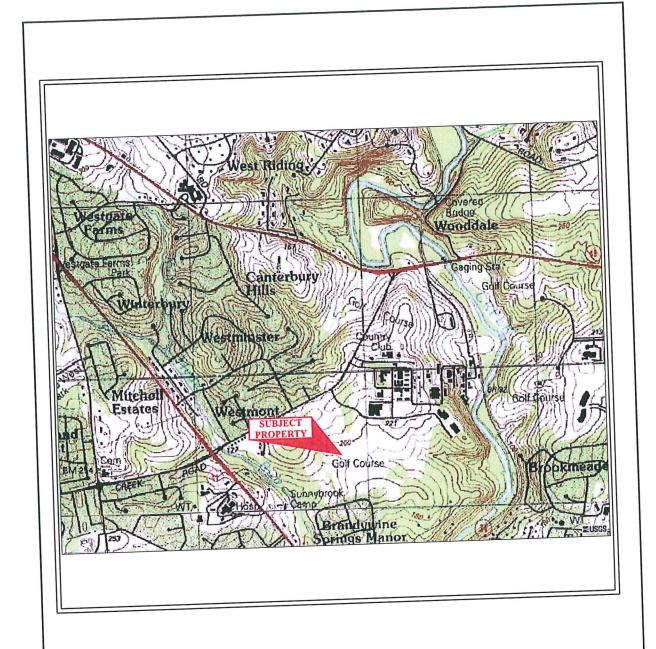
Program Manager

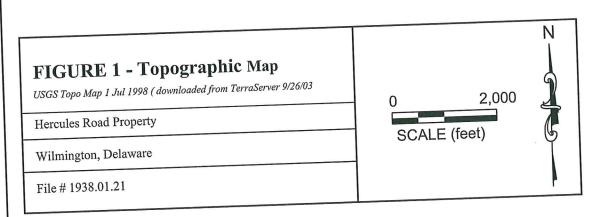
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# FIGURE 1



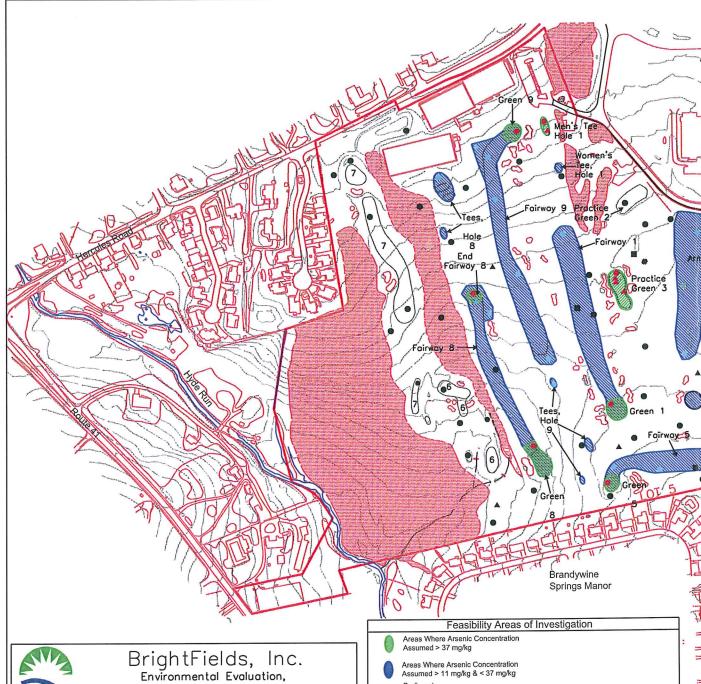




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FIGURE 2





Investigation, and Remediation

801 Industrial Street, Suite 1 Wilmington, Delaware 19801

302 656-9600 302 656-9700 fax

Soil Sample Locations Hercules Road Property Wilmington, Delaware

	BY	DATE	SCALE:	AC FIL	E:
DRAWN	SMD	3/2/07	1: 4800	All	Samples
CHECKED	JCH	3/2/07	DWG. NO.		REV.
PROJECT #	1938.0	3.21	FIGURE	2	0

- TriState Soil Sampling Location (Arsenic Concentration < 11 mg/kg)- February 2006
- TriState Soil Sampling Location (Arsenic Concentration > 11 and < 37 mg/kg)- February 2006
- TriState Soil Sampling Location (Red Where Arsenic Concentration > 37 mg/kg- February 2006
- BrightFields Soil Sampling Location (Arsenic Concentration < 11 mg/kg)- February 2006
- BrightFields Soil Sampling Location (Arsenic Concentration > 11 and < 37 mg/kg)- February 2006 BrightFields Soil Sampling Location (Red Where Arsenic Concentration > 37 mg/kg- February 2006
- BrightFields Test Pit Location (Arsenic Concentration
- Shight leds Test No. Control (Alsonic Concentration > 11 mg/kg)- January 2005

  BrightFields Test Pit Location (Arsenic Concentration > 11 and < 37 mg/kg)- January 2006

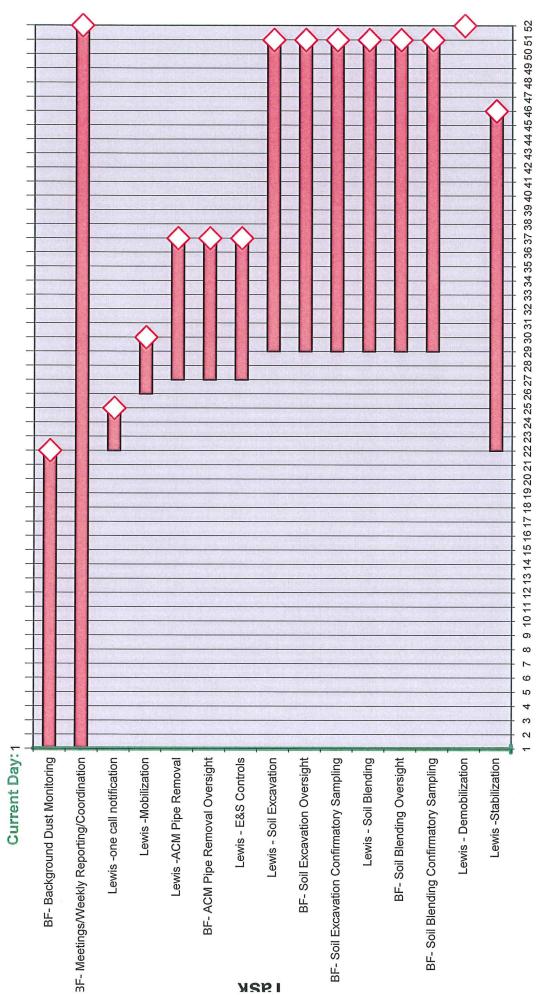


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# **Appendix A Remediation Timeline**

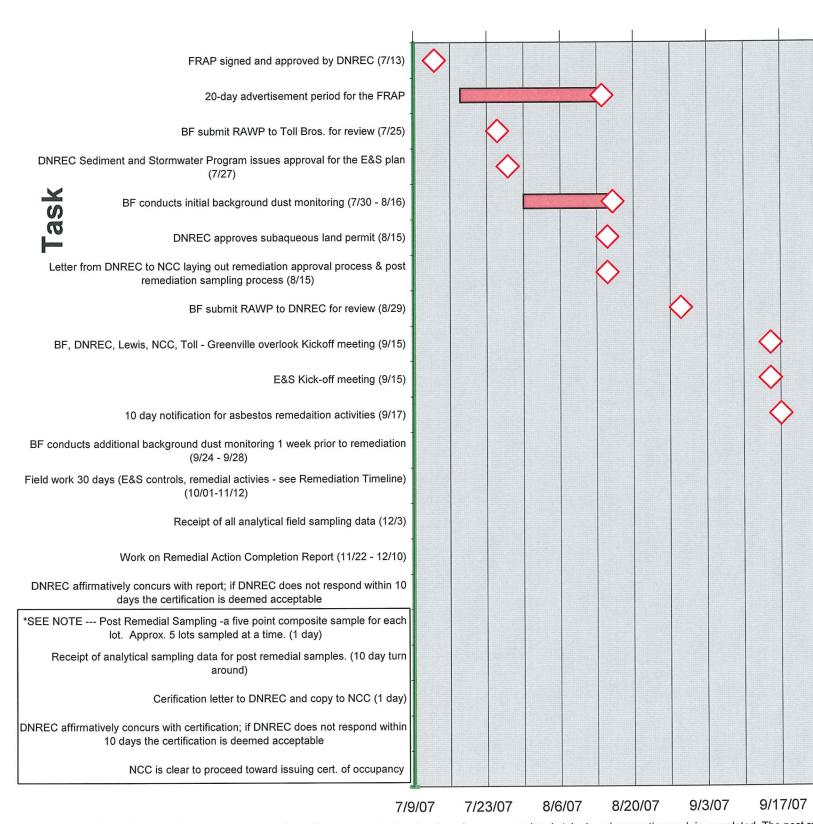
# **Greenville Overlook Remediation Timeline**



**Note:** Post remedial confirmatory sampling will occur once building lots have been surveyed and staked, and excavation work is completed. The post remedial sampling task is not represented on this timeline.

Dav#

# **Greenville Overlook R**



<sup>\*</sup> Note: Post remedial confirmatory sampling will occur once building lots have been surveyed and staked, and excavation work is completed. The post retasks will occur in phases as lots are prepared. The tasks that appear in the box above represent one complete cycle.
\*Performance dates are estimated.

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# **Appendix B Construction Sequence**

### Sequence of construction

### General

- 1. Subsequent to a pre-construction meeting with new castle county (ncc), notify ncc and deldot district supervisor at least 48 hours before any work begins.
- 2. Verify critical elevations at discharge points throughout the project.
- 3. Inspect drainageways and the discharge points of the proposed pre-bulk soil erosion and sediment control structures for stability. If needed, these areas must be stabilized with either vegetative or non-vegetative methods such as stabilization matting prior to construction of the pre-bulk soil erosion and sediment controls that discharge to them.
- 4. Stabilize the disturbed area for any pre-bulk soil erosion and sediment control structure or diversion within 5 days of completion.
- 5. The overlap of pre- and post-bulk construction between phases may occur provided that the total unstabilized disturbed area does not exceed twenty (20) acres.
- 6. Water quality runoff to the proposed bioretention facilities must be blocked at the diversion control structure and the interior weir not installed until removal of the prebulk soil erosion and sediment controls and preparation of the open space for dedication occurs in phase 6.
- 7. Stream stabilization work will not be started until removal of the pre-bulk soil erosion and sediment controls and preparation of the open space for dedication occurs in phase 6 in accordance with ncc unified development code section 40.27.440.c.

### Pre-soil remediation

- 1. Notify delaware natural resources & environmental control (dnrec) at least 48 hours before any work begins.
- 2. Construct the stabilized construction entrance and truck wash area located at the east end of the hercules road frontage.
- 3. Stakeout and construct silt fence, stone check dams and limit of clearing.
- 4. Clear surface vegetation and trees for perimeter contols.
- 5. Construct temporary sediment basins tsb-5 and tsb-13, pipe outlet sediment traps pst-14 and pst-16 and their respective discharge outfall pipes.
- 6. Construct vegetated channel vc-t4 downstream of the tsb-13 discharge outfall pipe.

- 7. Construct the diversions that drain to the pre-bulk soil erosion and sediment control structures. Temporary swale ts-b2.28 drains to tsb-5. Temporary swales ts-a1.15 and ts-b2.30 drain to tsb-13. Temporary swale ts-a3.26 drains to pst-14. Temporary swale ts-a1.17 drains to pst-16.
- 8. Construct remaining temporary swales ts-a1.16, ts-a1.18 and ts-b2.29 and temporary berms tb-a1.10, tb-a1.11, tb-a1.13, tb-a2.11, tb-a2.12 and tb-a3.10 to drain non-sediment laden water.
- 9. Construct permanent swale g and temporary swale ts.a3.24 to drain non-sediment laden water.
- 10. Contact dnrec for a pre-bulk inspection prior to commencing any soil remediation activities.

### Soil remediation

- 1. Perform the soil remediation as identified in the approved remedial action work plan under the observation and direction of the remediation consultant and dnrec.
- 2. Construct haul roads through areas a and b and up to area c.
- 3. Perform remediation beginning with area a, then area b and ending with area c.
- 4. Provide temporary stabilization within 7 days of completion of remediation and testing of each area.
- 5. Construct vegetated channel vc-t1 and temporary channel crossing tc-c1.
- 6. Construct haul roads through area d.
- 7. Perform remediation in area d.
- 8. Provide temporary stabilization within 7 days of completion of remediation and testing of area d.

### Post-soil remediation

- 1. Remove pipe outlet sediment traps pst-14 and pst-16 and the diversions that drain to them.
- 2. Remove temporary sediment basin tsb-13, the diversions that drain to it and the vegetated channel that drains from it.

- 3. Remove remaining temporary swales ts-a1.16, ts-a1.18, the portion of ts-b2.28 that is outside the riparian buffer and ts-b2.29 and temporary berms tb-a2.11, tb-a2.12 and tb-a3.10.
- 4. Remove all non-perimeter silt fence and stone check dams.
- 5. Provide ncc with documentation of "no further action".

## Phase 1 pre-bulk grading

- 1. Install orange safety fence around bioretention facilities #1, 2 and 3.
- 2. Modify the existing basin into pipe outlet sediment trap pst-1 by providing culvert inlet protection around the existing outlet control structure.
- 3. Demolish, remove and reconstruct the storm sewer along hercules road and provide temporary connection of the existing discharge outfall pipe from pst-1 to proposed inlet #256. Inlet protection shall be installed concurrently with the inlet structures.
- 4. Stakeout and construct silt fence and limit of clearing.
- 5. Perform demolition of all existing on-site infrastructure.
- 6. Construct the stabilized construction entrance located at the olympus place intersection with hercules road.
- 7. Remove the stabilized construction entrance and truck wash area located at the east end of the hercules road frontage.
- 8. Clear surface vegetation and trees for perimeter controls.
- 9. Construct sanitary sewer main between the existing manhole at the hyde run interceptor and proposed manhole #30 including the steel casing pipe between proposed manholes #9a and 10.
- 10. Construct pipe outlet sediment trap pst-3 and temporary sediment basin tsb-4 and their respective discharge outfall pipes.
- 11. Construct the diversions that drain to the pre-bulk soil erosion and sediment control structures. Temporary swale ts-a3.01 drains to pst-1. Permanent swale f and temporary swales ts-a3.02 and ts-a3.03 drain to pst-3. Temporary swales ts-a3.04, ts-a3.06 and ts-b2.07 drain to tsb-4.

- 12. Prior to requesting a pre-bulk inspection from ncc, a certified construction reviewer shall submit a compliance report declaring that all pre-bulk soil erosion and sediment controls are installed and function properly.
- 13. Contact ncc for a pre-bulk soil erosion and sediment control inspection prior to any earth disturbing activities.

### Phase 1 post-bulk grading

- 1. Temporarily stabilize all disturbed area outside of the right-of-way within 14 days.
- 2. Install individual on lot temporary soil erosion and sediment controls prior to commencing building construction on model home lots #1, 86, 87, 88, 89, 90 and 160.
- 3. Commence construction on model home lots #1, 86, 87, 88, 89, 90 and 160 provided that the necessary building permits have been issued and appropriate inspection access is provided.
- 4. Construct utilities. Inlet protection shall be installed concurrently with the inlet structures.
- 5. Construct curb and stone base course for roads.
- 6. Contact ncc for post-bulk inspection prior to release of remaining building permits.
- 7. Install individual on lot temporary soil erosion and sediment controls prior to commencing building construction.
- 8. Remove the stabilized construction entrance located at the olympus place intersection with hercules road and replace with stone base course for roads.
- 9. Construct pavement base course. Block access to phase 2 at arcadia way and provide stabilized construction entrances to phases #2 and 3 on oracle road and odyssey drive, respectively.
- 10. Install silt fence behind curb after construction of "dry" utilities.

### Phase 2 pre-bulk grading

- 1. Install orange safety fence around bioretention facilities #4 and 7.
- 2. Construct temporary swale ts-b2.24 that drains into temporary swale ts-b2.28 remaining from soil remediation.

- 3. Construct permanent swale g and temporary swale ts-a3.24 to divert "clean" runoff from the adjacent homes around temporary sediment basin tsb-5.
- 4. Prior to requesting a pre-bulk inspection from ncc, a certified construction reviewer shall submit a compliance report declaring that all pre-bulk soil erosion and sediment controls are installed and function properly.
- 5. Contact ncc for a pre-bulk inspection prior to any earth disturbing activities.

### Phase 2 post-bulk grading

- 1. Temporarily stabilize all disturbed area outside of the right-of-way within 14 days.
- 2. Construct utilities. Inlet protection shall be installed concurrently with the inlet structures.
- 3. Construct curb and stone base course for roads. Provide stabilized construction entrance to phase #3 on oracle road.
- 4. Contact ncc for post-bulk inspection prior to release of building permits.
- 5. Install individual on lot temporary soil erosion and sediment controls prior to commencing building construction.
- 6. Install silt fence behind curb after construction of "dry" utilities.

### Phase 3 pre-bulk grading

- 1. Install orange safety fence around bioretention facilities #6a and 6b.
- Construct pipe outlet sediment trap pst-2 and temporary sediment basin tsb-6 and their respective discharge outfall pipes.
- 3. Construct the diversions that drain to the pre-bulk soil erosion and sediment control structures. Temporary swale ts-a1.12 drains to pst-2. Temporary swale ts-b2.09 drains to tsb-6.
- 4. Prior to requesting a pre-bulk inspection from ncc, a certified construction reviewer shall submit a compliance report declaring that all pre-bulk soil erosion and sediment controls are installed and function properly.
- 5. Contact ncc for a pre-bulk inspection prior to any earth disturbing activities.

# Phase 3 post-bulk grading

- 1. Temporarily stabilize all disturbed area outside of the right-of-way within 14 days.
- Construct utilities. Inlet protection shall be installed concurrently with the inlet structures.
- Construct curb and stone base course for roads.
- 4. Contact ncc for post-bulk inspection prior to release of building permits.
- 5. Install individual on lot temporary soil erosion and sediment controls prior to commencing building construction.
- 6. Remove access block between phases #1 and 2 on arcadia way.
- 7. Construct pavement base course for phases #2 and 3. Provide stabilized construction entrance to phases #4 and 5 on athena court and odyssey drive, respectively.
- 8. Install silt fence behind curb after construction of "dry" utilities.

# Phase 4 pre-bulk grading

- 1. Install orange safety fence around bioretention facility #8.
- Construct permanent stormwater management facility b-3 and its discharge outfall pipe.
- 3. Construct temporary sediment basin tsb-12 and its discharge outfall pipe into stormwater management facility b-3.
- 4. Construct temporary swale ts-b2.15 and temporary berm tb-a1.14 that drain to temporary sediment basin tsb-12.
- Construct off-site sanitary sewer main relocation in adjacent parcel #6 (tax parcel 08-027.00-002).
- 6. Demolish and remove existing sanitary sewer main.
- 7. Prior to requesting a pre-bulk inspection from ncc, a certified construction reviewer shall submit a compliance report declaring that all pre-bulk soil erosion and sediment controls are installed and function properly.
- 8. Contact ncc for a pre-bulk inspection prior to any earth disturbing activities.

### Phase 4 post-bulk grading

- 1. Temporarily stabilize all disturbed area outside of the right-of-way within 14 days.
- 2. Construct utilities. Inlet protection shall be installed concurrently with the inlet structures.
- 3. Construct curb and stone base course for roads.
- 4. Contact ncc for post-bulk inspection prior to release of building permits.
- 5. Install individual on lot temporary soil erosion and sediment controls prior to commencing building construction.
- 6. Install silt fence behind curb after construction of "dry" utilities.

### Phase 5 pre-bulk grading

- 1. Install orange safety fence around bioretention facilities #5 and 9.
- 2. Construct permanent stormwater management facility b-2 and its discharge outfall pipe.
- 3. Construct pipe outlet sediment traps pst-7, pst-8, pst-9, pst-10 and pst-11 and their respective discharge outfall pipes.
- 4. Construct temporary swale ts-a3.22 downstream of the pst-9 discharge outfall pipe.
- 5. Construct the diversions that drain to the pre-bulk soil erosion and sediment control structures. Temporary berm tb-a1.16 drains to pst-7. Temporary berms tb-a1.17 and tb-a1.18 drain to pst-8. Temporary swale ts-a3.19 drains to pst-9. Temporary swale ts-a3.21 drains to pst-10. Temporary swales ts-a3.20 and ts-a3.23 drain to pst-11.
- 9. Prior to requesting a pre-bulk inspection from ncc, a certified construction reviewer shall submit a compliance report declaring that all pre-bulk soil erosion and sediment controls are installed and function properly.
- 6. Contact ncc for a pre-bulk inspection prior to any earth disturbing activities.

### Phase 5 post-bulk grading

1. Temporarily stabilize all disturbed area outside of the right-of-way within 14 days.

- 2. Construct utilities. Inlet protection shall be installed concurrently with the inlet structures.
- 3. Construct curb and stone base course for roads.
- 4. Contact ncc for post-bulk inspection prior to release of building permits.
- 5. Install individual on lot temporary soil erosion and sediment controls prior to commencing building construction.
- 6. Construct pavement base course for phases #4 and 5.
- 7. Install silt fence behind curb after construction of "dry" utilities.

Phase 6 removal of pre-bulk soil erosion and sediment controls and preparation of open space for dedication

- 1. Pipe outlet sediment trap pst-3, temporary swales ts-a3.01, ts-a3.02, ts-a3.03, ts-a3.04, ts-a3.06 and ts-b2.07 and temporary berm tb-a1.10 can be removed independently of each other as final grades are established and permanent vegetative stabilization is provided in accordance with the vegetative stabilization criteria.
- 2. Convert temporary sediment basin tsb-4 into a permanent stormwater management facility.
- 3. Temporary swales ts-a3.24, ts-b2.24 and ts-b2.28 can be removed independently of each other as final grades are established and permanent vegetative stabilization is provided in accordance with the vegetative stabilization criteria.
- 4. Convert temporary sediment basin tsb-5 into a permanent stormwater management facility.
- 5. Pipe outlet sediment trap pst-2, temporary swales ts-a1.12 and ts-b2.09 and temporary berm tb-a1.11 can be removed independently of each other as final grades are established and permanent vegetative stabilization is provided in accordance with the vegetative stabilization criteria.
- 6. Convert temporary sediment basin tsb-6 into a permanent stormwater management facility.
- 7. Temporary sediment basin tsb-12, temporary swale ts-b2.15 and temporary berm tb-a1.14 can be removed independently of each other as final grades are established and permanent vegetative stabilization is provided in accordance with the vegetative stabilization criteria.

- 8. Pipe outlet sediment traps pst-7, pst-8, pst-9, pst-10 and pst-11, temporary swales ts-a3.19, ts-a3.20, ts-a3.21, ts-a3.22 and ts-a3.23 and temporary berms tb-a1.16, tb-a1.17, tb-a1.18 can be removed independently of each other as final grades are established and permanent vegetative stabilization is provided in accordance with the vegetative stabilization criteria.
- 9. Fine grade and permanently stabilize remaining private open space in accordance with the vegetative stabilization criteria.
- 10. Install interior weir in the diversion control structures and divert water quality runoff to bioretention facilities #1, 2, 3, 4, 5, 6a, 6b, 7, 8, and 9.
- 11. Remove silt fence and inlet protection.

### Phase 6 stream stabilization

- 1. Perform the stream stabilization as identified in the approved stream stabilization report under the observation and direction of the stream stabilization consultant.
- 2. Construct stream diversion measures.
- 3. Remove sediment from the stream to an approved on-site location.
- 4. Strip 4" of topsoil from the stream and stockpile.
- 5. Construct rock grade control structures.
- 6. Excavate channel, install stabilization matting and construct log cross vanes.
- 7. Fine grade and permanently stabilize stream stabilization area in accordance with the vegetative stabilization criteria.

Mr. Stephen Johnson, P.E. August 28, 2007 1938.03.21



# Appendix C Confirmatory Sampling Design

# Systematic sampling locations for detecting an area of elevated values (hot spot)

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SA	MPLING DESIGN
Primary Objective of Design	Detect the presence of a hot spot that has a specified size and shape
Type of Sampling Design	Hot spot
Sample Placement (Location) in the Field	Systematic (Hot Spot) with a random start location
Formula for calculating number of sampling locations	Singer and Wickman algorithm
Calculated total number of samples	84
Type of samples	Point Samples
Number of samples on map <sup>a</sup>	81
Number of selected sample areas b	1
Specified sampling area c	507397.15 ft <sup>2</sup>
Grid pattern	Triangular
Size of grid / Area of grid <sup>d</sup>	83.9205 feet / 6099.11 ft <sup>2</sup>
Total cost of sampling e	\$43000.00
- 02-00-00-00-00-00-00-00-00-00-00-00-00-0	

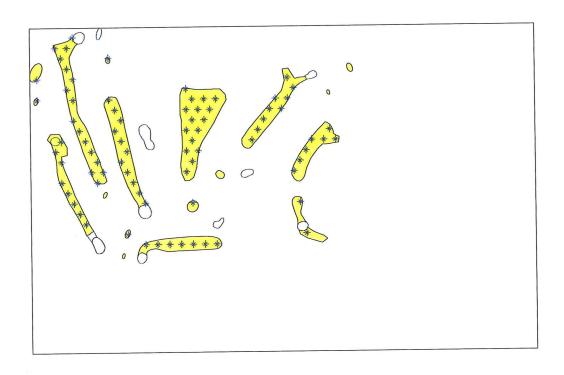
<sup>&</sup>lt;sup>a</sup> This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3)

<sup>&</sup>lt;sup>b</sup> The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.

<sup>&</sup>lt;sup>c</sup> The sampling area is the total surface area of the selected colored sample areas on the map of the site.

d Size of grid / Area of grid gives the linear and square dimensions of the grid spacing used to systematically place

e Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: Area 1						
X Coord	Y Coord	Label	Value	Type	Historical	
592583.8054	637911.7647			Hotspot		
592667.7258	637911.7647			Hotspot		
592751.6463	637911.7647			Hotspot		
592835.5668	637911.7647			Hotspot		
592919.4873	637911.7647			Hotspot		
593003.4077	637911.7647			Hotspot		
593087.3282	637911.7647			Hotspot		
592457.9246	637984.4420			Hotspot		
593716.7318	637984.4420			Hotspot		
592164.2030	638057.1192			Hotspot		
592122.2427	638129.7965			Hotspot		
592080.2825	638202.4738			Hotspot		
592583.8054	638202.4738			Hotspot		
592919.4873	638202.4738			Hotspot		
593674.7716	638202.4738			Hotspot		
592038.3223	638275.1510			Hotspot		
592541.8451	638275.1510			Hotspot		
591996.3620	638347.8283			Hotspot		
592248.1234	638347.8283			Hotspot		
592499.8849	638347.8283			Hotspot	:	
592206.1632	638420.5055	5		Hotspo	t	
592290.0837	638420.5055	5		Hotspo	t	

	Hotopot
592457.9246 638420.5055	Hotspot
592877.5270 638420.5055	Hotspot
593632.8113 638420.5055	Hotspot
591996.3620 638493.1828	Hotspot
592248.1234 638493.1828	Hotspot
592415.9644 638493.1828	Hotspot
592919.4873 638493.1828	Hotspot
593674.7716 638493.1828	Hotspot
591954.4018 638565.8601	Hotspot
592206.1632 638565.8601	Hotspot
592457.9246 638565.8601	Hotspot
592877.5270 638565.8601	Hotspot
592961.4475 638565.8601	Hotspot
593716.7318 638565.8601	Hotspot
591996.3620 638638.5373	3 Hotspot
592164.2030 638638.5373	Hotspot
592415.9644 638638.5373	3 Hotspot
592919.4873 638638.5373	3 Hotspot
593339.0896 638638.537	3 Hotspot
593758.6920 638638.537	3 Hotspot
593842.6125 638638.537	3 Hotspot
593926.5330 638638.537	3 Hotspot
592122.2427 638711.214	6 Hotspot
592374.0042 638711.214	6 Hotspot
592877.5270 638711.214	6 Hotspot
592961.4475 638711.214	16 Hotspot
593381.0499 638711.214	Hotspot
593884.5727 638711.214	16 Hotspot
592080.2825 638783.89	19 Hotspot
592415.9644 638783.89	19 Hotspot
592919.4873 638783.89	19 Hotspot
593003.4077 638783.89	19 Hotspot
593423.0101 638783.89	19 Hotspot
592374.0042 638856.56	91 Hotspot
592877.5270 638856.56	91 Hotspot
592961.4475 638856.56	
593045.3680 638856.56	
593464.9704 638856.56	
000.0	
593548.8908 638856.56	

			٦
592080.2825	638929.2464	Hotspot	
592332.0439	638929.2464	Hotspot	
592919.4873	638929.2464	Hotspot	
593003.4077	638929.2464	Hotspot	
593087.3282	638929.2464	Hotspot	
593506.9306	638929.2464	Hotspot	
593590.8511	638929.2464	Hotspot	
592038.3223	639001.9237	Hotspot	
592877.5270	639001.9237	Hotspot	
593632.8113	639001.9237	Hotspot	
591828.5211	639074.6009	Hotspot	
592080.2825	639074.6009	Hotspot	
593590.8511	639074.6009	Hotspot	
592038.3223	639147.2782	Hotspot	
591996.3620	639219.9555	Hotspot	
592332.0439	639219.9555	Hotspot	1
591954.4018	639292.6327	Hotspot	1
592038.3223	639292.6327	Hotspot	
592080.282	639365.3100	Hotspot	

The primary purpose of sampling at this site is to detect "hot spots" (local areas of elevated concentration) of a given size and shape with a specified probability, 1-β.

This sampling approach requires systematic grid sampling with a random start. If a systematic grid is not used, the probability of detecting a hot spot of a given size and shape will be different than desired or calculated.

Number of Total Samples: Calculation Equation and Inputs

The algorithm used to calculate the grid size (and hence, the number of samples) is based on work by Singer for locating geologic deposits [see Singer (1972, 1975) and PNNL-13450 for details]. Inputs to the algorithm include the size, shape, and orientation of a hot spot of interest, an acceptable probability of not finding a hot spot, the desired type of sampling grid, and the sampling budget. For this design, the grid size was calculated based on a given hot spot size and other parameters.

The inputs to the algorithm that result in the grid size are:

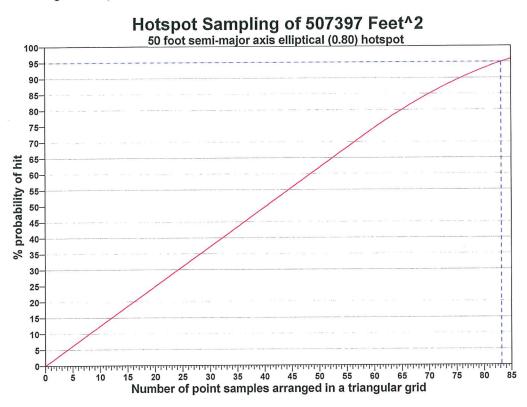
Parameter	Description	Value
Inputs		
1-β	Probability of detection	95%
Grid Type	Grid pattern (Square, Triangular or Rectangular)	Triangular
	Point samples or square cells	Points
Sample Type	1.101	0.8
Hot Spot Shape	Length of hot spot semi-major axis	50 feet
Hot Spot Size		6283.19 ft <sup>2</sup>
Hot Spot Area a	Area of hot spot (Length <sup>2</sup> * Shape * π)	Random
Angle	Angle of orientation between hot spot and grid	Tandoni

Sampling Area	Total area to sample	507397.15 ft <sup>2</sup>
Outputs		
Grid Size	Spacing between samples	83.9205 feet
Grid Area	Area represented by one grid	6099.11 ft <sup>2</sup>
Samples <sup>b</sup>	Optimum number of samples	83.192
Cost	Total cost of sampling	\$43000.00

<sup>a</sup> Length of semi-major axis is used by algorithm. Hot spot area is provided for informational purposes.

<sup>b</sup> The optimum number of samples is calculated by dividing the sampling area by the grid area.

The following graph shows the relationship between number of samples and the probability of finding the hot spot. The dashed blue line shows the actual number of samples for this design (which may differ from the optimum number of samples because of edge effects).



### **Statistical Assumptions**

The assumptions associated with the sample spacing algorithm are that:

- 1. the target hot spot (its projection onto the coordinate plane) is circular or elliptical,
- 2. samples are taken on a square, rectangular, or triangular grid,
- 3. a very small proportion of the area being studied will be sampled (the sample is much smaller than the hot spot of interest).
- 4. the level of contamination that classifies a hot spot is well defined, and
- 5. there are no misclassification errors (a hot spot is not mistakenly overlooked or an area is not mistakenly identified as a hot spot).

These assumptions cannot be validated through data collection. The size and shape of a hot spot of interest are well defined prior to determining the number of samples and the measured value that defines a hot spot is well above the detection limit for the analytical methods that will be used. Grid sampling will be carried out to the level achievable; topographic, vegetative, and other features that prevent sampling at the specified coordinates will be noted and their influence recognized.

The sensitivity of the calculation of number of samples was explored by varying 1-β, Shp and Size and examining the resulting changes in the number of samples. The following table shows the results of this analysis.

Number of Samples							
Size=25 Size=50 Size=75							
	Shp=0.7	364	91	41			
1-β=90	Shp=0.8	304	76	34			
	Shp=0.9	263	66	30			
1-β=95	Shp=0.7	404	101	45			
	Shp=0.8	333	84	37			
	Shp=0.9	286	72	32			
1-β=100	Shp=0.7		124	55			
			102	45			
	Shp=0.9		88	39			

1-β = Probability of Hit (%)

Shp = Hot Spot Shape (Height to Width Ratio)

Size = Hot Spot Size (Length of Semi-major Axis)

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is \$43000.00, which averages out to a per sample cost of \$511.90. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION						
Cost Details	Per Analysis	Per Sample	84 Samples			
Field collection costs		\$100.00	\$8400.00			
	\$400.00	\$400.00	\$33600.00			
Analytical costs	<b>V</b> 133131	\$500.00	\$42000.00			
Sum of Field & Analytical costs		φοσοίσο	\$1000.00			
Fixed planning and validation costs						
Total cost			\$43000.00			

**Recommended Data Analysis Activities** 

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2000). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

A map of the actual sample locations will be generated so that the sampling plan and the field implementation may be compared. Deviations from planned sample locations due to topographic, vegetative, or other features will be noted. Their impacts will be qualitatively assessed. If a hot spot is discovered, additional sampling may be performed to determine its size and shape, in which case, the initial assumptions of the sampling design may then be assessed and/or reconsidered.

* - The report contents may have been mo	dified or reformatted by end-user of software.	

Mr. Stephen Johnson, P.E. August 28, 2007 1938.03.21



# Appendix D Individual Lot Sampling Confirmation Letter

Stephen Johnson, P.E.
Delaware Department of Natural Resources and Environmental Control
Site Investigation and Restoration Branch
391 Lukens Drive
New Castle, DE 19720

Re:

Post-Remedial Confirmatory Sampling Results

Lot Number XXXX

Greeneville Overlook Development

Wilmington, Delaware

On behalf of Toll Bros, Inc., BrightFields, Inc. is providing this documentation stating that the property identified as Lot Number XXXX complies with the environmental quality criteria established by the State of Delaware, Department of Natural Resources and Environmental Control, Site Investigation and Restoration Branch (DNREC-SIRB).

BrightFields completed sampling for Lot Number XXXX on \_\_\_\_\_\_, 200? and compared the laboratory analytical results to the referenced Remedial Action Objectives (RAOs). The results of the sampling event are presented in the attached table and indicate that the soil conditions on Lot Number XXXX comply with the RAOs; therefore, no further remedial action is necessary on this lot.

If you have any questions concerning this plan, please do not hesitate to contact me at (302) 656-9600.

Sincerely, **BrightFields**, Inc.

J. Curtis Hatfield Program Manager

cc: Charlie Baker - New Castle County Land Use

### Greenville Overlook:

## Lot by Lot Sampling Results

Sampling Date:	Analysis Date:
Street Address:	Tax Parcel #

	Target	Composite Sample
Analyte <sup>1</sup>	Concentration	Results <sup>2</sup>
	(mg/kg)	(mg/kg)
Aldrin	0.04	
Arsenic	11	
Cadmium	4	
Chlordane	2	
Dieldrin	0.04	
Heptachlor	0.07	
epoxide		
Lead	400	
Mercury	10	

<sup>&</sup>lt;sup>1</sup> The 8 analytes listed are the designated contaminants of concern identified in the Toll Brothers Final Remedial Action Plan (July 9, 2007) approved by DNREC July 13, 2007.

<sup>&</sup>lt;sup>2</sup> Laboratory "Form 1" attached.

Mr. Stephen Johnson, P.E. August 28, 2007 1938.03.21



## Appendix E Perimeter Air Monitoring Plan

## PERIMETER AIR MONITORING PLAN

# For Remediation Activities at the Hercules Road Property Wilmington, Delaware

Prepared For:

Toll Brothers, Inc. 2747 Philmont Avenue Huntingdon Valley, Pennsylvania

April 18, 2007

Prepared By:



801 Industrial Street, Suite 1 Wilmington, Delaware 302-656-9600

BrightFields File: 1938.03.21



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#### 1.0 INTRODUCTION

The Hercules Road Property (Property) is located on Hercules Road, approximately 2,000 feet west of the Newport Gap Pike (State Route 41) and south of Lancaster Pike (State Route 48) in Wilmington, Delaware (Figure 1).

The Property is composed of two tax parcels. The northern parcel is currently used as a nine-hole golf course and covers an area of approximately 101 acres (tax parcel ID# 08-026.00-052 [Lot 5]). The parcel has been maintained as a golf course since 1947. The southern parcel is unoccupied and wooded and is approximately 61 acres (tax parcel ID# 08-033.00-001 [Lot 10]). The surrounding land is generally residential. Toll Brothers is currently in negotiations with the current owner, Chaps 901, LLC, to purchase the Property for residential development.

Over the years pesticides have been used at the Hercules Road property. Arsenic compounds were one of the ingredients in some pesticides used before the EPA banned most inorganic arsenic pesticides in 1986. Elevated arsenic areas have been found in various areas on the Property. Portions of the Property are planned to be excavated to remove the elevated levels of arsenic. In addition, soil containing lower concentrations of arsenic will be blended with unimpacted soil to lower arsenic concentrations to within background levels.

During excavation/blending activities the dust concentrations in the air at the actual excavation/blending operation will be monitored for dust particulates using a Personal Datalogging Real-time Aerosol Monitor (DataRAM), which is a hand held dust meter. Protection of excavation workers will be performed by monitoring dust particulates at the location of the excavating/blending activities and taking actions as needed consistent with Section 3 of the Health and Safety Plan (HASP) for Construction Activities Associated with Hercules Road Property, March 2007. The worker health and safety program is detailed in that HASP.

In addition, during excavation/blending activities, the dust concentrations in the air around the perimeter of the property will also be monitored using dust meters. This perimeter monitoring will be undertaken using Environmental Particulate Air Monitors (EPAM-5000), or equivalent, to evaluate if dust is extending beyond the point of excavation. Dust reducing procedures are an integral part of the remediation scope of work and actions to be taken in the event that dust levels rise are also spelled out in the scope of work.



This document presents the perimeter air monitoring program. The objectives of the perimeter air monitoring program are to:

- Monitor and document perimeter ambient air concentrations of dust while intrusive remediation activities are occurring at Hercules Road Property;
- Provide a guide to evaluate the need for more rigorous dust control measures for reducing airborne concentrations of dust; and
- Protect the health and safety of residents and passers by by keeping dust concentrations below an action level determined to be protective of residents, as detailed below.



#### 2.0 AIR ACTION LEVEL

This plan is intended to prevent respirable particulate matter from affecting residents and passersby. Respirable particles are small enough to be inhaled (respired) into the lungs and include particulates 10 microns or less in diameter. This size airborne Particulate Matter (PM) is known as PM10.

Risk Based Action Level. Avatar Environmental, LLC was tasked by BrightFields to develop contaminant-specific risk-based PM<sub>10</sub> (i.e., particles less than 10 microns) Action Levels based on contaminant levels in the soil at the Hercules Road Property. The objective of this analysis was to estimate health protective PM<sub>10</sub> levels that will ensure that nearby residents will not be exposed to unacceptable concentrations of site-related contaminants resulting from inhaling dust generated during remediation activities.

Site-specific air Risk Based Concentrations (RBCs) were calculated following the methodology recommended by EPA Region 3. A target cancer risk (TR) of 1E-06 (also termed one in a million) was used for contaminants known or suspected to be carcinogens. A target hazard quotient (THQ) of 1 was used for noncancer effects. RBCs were estimated for both a child and adult resident using standard EPA default values for body weight, inhalation rate, lifetime, etc. All detected contaminants in site soils were included in the analysis using the 95% upper-confidence limit of detected concentrations in soil, which is standard EPA practice. The inhalation cancer slope factors and reference doses were obtained from EPA's Integrated Risk Information System (IRIS). A conservative project duration of three months was assumed for the exposure duration.

Using this risk based approach, arsenic resulted in the most stringent  $PM_{10}$  Action Level (0.870 mg/m<sup>3</sup>). If the  $PM_{10}$  concentrations are less than the arsenic Action Level, they would also be less than the Action Levels for all other known soil contaminants. The full report from Avatar Environmental is provided in Attachment A.

National Ambient Air Quality Standard. In addition to the risk based approach, BrightFields also researched other air quality standards that may apply to the remediation at the Hercules Road



Property. The Clean Air Act required EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. Primary standards were set to protect public health, including the health of sensitive populations such as asthmatics, children and the elderly. The primary standard for particulate matter ( $PM_{10}$ ) is 0.150 mg/m<sup>3</sup>. The primary standard is based on a 24-hour average concentration.

<u>Selected Action Level.</u> The more protective of the risk based action level and the NAAQS is selected as the perimeter air monitoring action level. For the EPAM-5000 (perimeter air monitoring) dust meter, the PM 10 particulate matter action level is set at 0.150 mg/m<sup>3</sup> in the breathing zone. Because excavation activities primarily occur only during daylight hours, using an action level that is based on 24-hour average exposure is a conservative approach to avoid exceeding the NAAQS.

#### 3.0 AIR MONITORING PROCEDURES, RESPONSES, AND QUALITY CONTROL

EPAM-5000 perimeter air readings will be obtained using real time monitoring equipment at least every 2 hours at pre-selected locations along the perimeter of the Property. Time averaged PM10 readings will be obtained at each monitored location. Proposed monitoring locations relative to the redevelopment area are shown on Figure 1. The monitoring locations are intended to be stationary and have been spatially located primarily near the residential area boundaries.

A portable weather station will be set up on site. The weather station will record at a minimum: temperature, humidity, wind direction, and wind speed and these parameters will be downloaded. Wind direction for the day will be filed with the air monitoring log to provide a historical record of wind direction and air monitoring results.

#### 3.1 Air Monitoring Procedures

Air monitoring will be performed by the individual performing environmental health and safety oversight for excavation activities on the redevelopment area. The following perimeter air monitoring equipment will be used to perform the air monitoring:

A EPAM-5000, or equivalent, that is capable of measuring PM10 will be used to
monitor airborne dust around the perimeter of the Property. Dust meters will be
stationary at the selected locations and measure dust concentrations continuously
(readings obtained every 60 seconds) during work hours. Time averaged dust
readings will be read and logged every two hours. If the two hour average exceeds
the action level, dust control measures will be implemented.



All air monitoring equipment will be calibrated according to the manufacturer's specifications prior to use each day. The time of calibration, calibration technique, and name of the person performing the calibration will be recorded in the log book.

Readings will be taken at breathing zone height (approximately 5 feet above ground surface). If readings are above the specified action levels, appropriate safety measures will be taken as described below. The monitoring time and air monitoring equipment readings will be recorded on the Perimeter Air Monitoring Log (Attachment B).

#### 3.2 Air Monitoring Response

If monitoring of air indicates that action levels are exceeded, excavation activities will stop and engineering controls will be applied until all air monitoring measurements return to an acceptable level. Action levels for the perimeter dust meters are considered to be exceeded if the two hour average dust concentration exceeds 0.150 mg/m<sup>3</sup>. If the action level is exceeded, the Delaware Department of Natural Resources and Environmental Control will be notified with details regarding the action level exceeded and actions taken.

For dust suppression, the following actions will be taken:

- Sufficient amounts of water will be available at the site.
- Work crews will maintain equipment to disperse water.
- The excavation and surrounding areas will be sprayed with water. A sufficient amount of water will be used to cover the area, but not so much that mud is created.

Dust suppression will be achieved during non-working times by stabilizing open excavations and areas disturbed during remediation. Seed and straw will be placed over disturbed soil in accordance with the Soil and Erosion Control Plan (Reviewed by DNREC Soil and Erosion Control Branch) to prevent dust generation. In addition, the remediation contractor will have staff available to water the site over weekends as necessary to control dust.

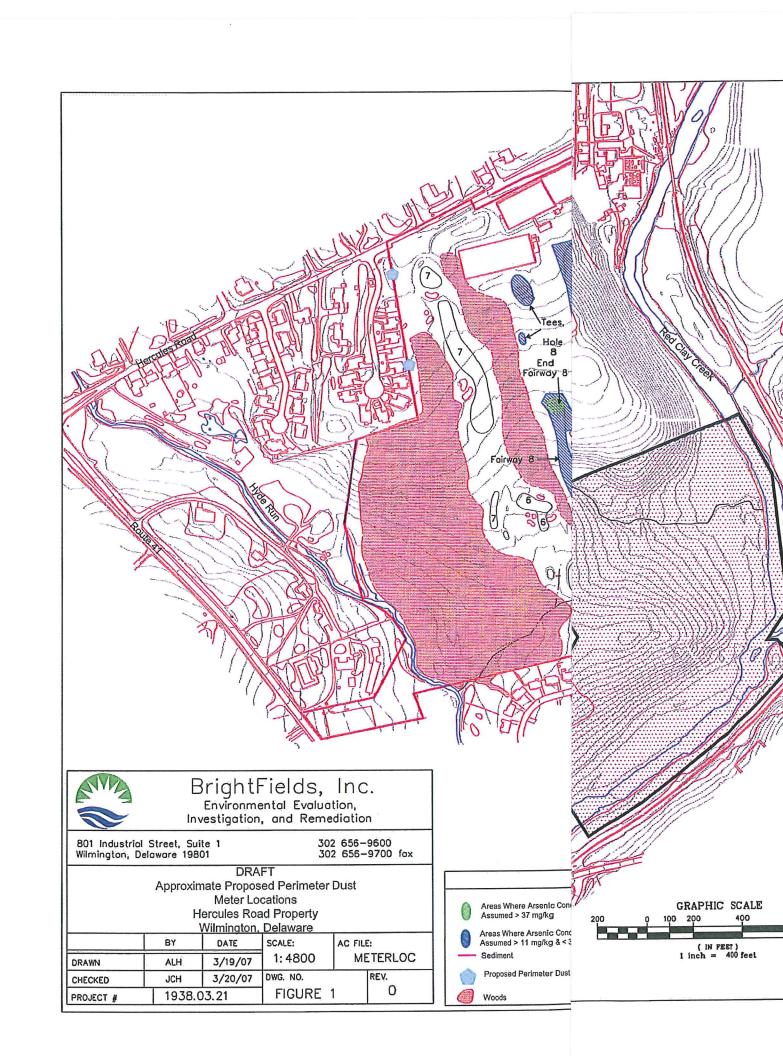
#### 3.3 Quality Control

Quality control of measurements will be performed by adhering to the daily equipment calibration and calibration record keeping. The dust meters will be zeroed daily before the start of field measurements using a dust filter. Calibration data will be entered into the field team member's log book and recorded on the Perimeter Air Monitoring log. Re-calibration and



zeroing will be performed any time the field team suspects a change in meter operation. Dust data will be downloaded at the end of the day and a permanent record of the daily data filed in the project file. Maintenance of meters will be performed according to manufacturer's recommendations and documented in meter specific maintenance logs.

## FIGURE 1 Perimeter Air Monitoring Locations







BrightFields, Inc. Environmental Evaluation, Investigation, and Remediation

801 Industrial Street, Suite 1 Wilmington, Delaware 19801

302 656-9600 302 656-9700 fax

#### DRAFT

Approximate Proposed Perimeter Dust Meter Locations

Hercules Road Property Wilmington, Delaware

	BY	DATE	SCALE:	AC FI	LE:
DRAWN	ALH	3/19/07	1:4800	N	ETERLOC
CHECKED	JCH	3/20/07	DWG. NO.		REV.
PROJECT #	1938.03.21		FIGURE	1	0

#### Legend



Areas Where Arsenic Concentration Assumed > 37 mg/kg



Areas Where Arsenic Concentration Assumed > 11 mg/kg & < 37 mg/kg



Proposed Perimeter Dust Meter Locations





# ATTACHMENT A Risk Based Air Action Level

BrightFields File: 1938.03.21

April 18, 2007

## RISK-BASED PM<sub>10</sub> ACTION LEVEL DEVELOPMENT

### Prepared for

BrightFields, Inc,

Submitted by Avatar Environmental, LLC 107 S. Church St. West Chester, PA 19382

April 18, 2007



A Service-Disabled Veteran Owned Small Business

## RISK-BASED PM<sub>10</sub> ACTION LEVEL DEVELOPMENT

### 1. INTRODUCTION AND OBJECTIVES

Avatar Environmental has been tasked by BrightFields to develop contaminant-specific risk-based PM<sub>10</sub> (i.e., particles less than 10 microns) Action Levels based on contaminant levels in the soil at the Hercules Road Property. The objective of this analysis is to estimate health protective PM<sub>10</sub> levels that will ensure that nearby residents will not be exposed to unacceptable concentrations of site-related contaminants resulting from inhaling dust generated during remediation activities.

Certain areas of the Golf Course on the Hercules Road Property (mainly the greens and tee boxes) have elevated levels of pesticides, herbicides, and metals in the soil as a result of past applications. Table 1-1 presents a summary of the contaminants that are present along with descriptive statistics. For areas that are targeted for remediation, BrightFields is planning on excavating the contaminated soil and replacing with clean fill, or mixing the soil with non-contaminated soil, depending on concentration levels. It is possible that during the planned excavation activities dust will be generated and potentially transported to the residential areas that border the Golf Course.

To monitor the  $PM_{10}$  concentrations, BrightFields is planning on implementing a network of sampling stations at the fence line where the residential homes are located. Data will be collected from these sampling stations during excavation activities and will be compared to a  $PM_{10}$  Action Level. The information will be used to alert the remediation team when exposures to  $PM_{10}$ , and ultimately to contaminants assumed to be associated with the  $PM_{10}$ , reach a level that required some type of action to reduce exposure (i.e., Action Level).

The first step in this process is to estimate health-protective risk-based air concentrations (RBCs) for each of the contaminants presented on Table 1-1. The approach followed to calculate the RBCs is presented in Section 2 and is consistent with EPA Region 3 (EPA, 2006). Next, the contaminant-specific PM<sub>10</sub> levels were calculated by relating the RBCs to the 95% upper-confidence limit (UCL) in soil for each contaminant. This approach is described in Section 3.

Table 1-1
Data Summary

Data Summary					
Contaminant	Number of Observations	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	95 % Upper- Confidence Limit (mg/kg)
0.000 0.000 0.000	50	3.50E-03	3.80E-01	4.92E-02	6.95E-02
4,4' -DDD	54	1.70E-03	2.50E+00	3.64E-01	4.85E-01
4,4' -DDE	54	4.00E-03	1.20E+00	1.95E-01	2.60E-01
4,4' -DDT	10	1.00E-03	6.10E-02	2.65E-02	4.00E-02
Aldrin	10	1.00E-03	3.80E-02	1.53E-02	3.66E-02
alpha-BHC	10	1.90E-02	9,40E+00	4.20E+00	1.18E+01
apha-Chlordane	54	1,30E-02	2.30E+02	1.94E+01	2.90E+01
Chlordane (tech)	6	1.00E-03	3.70E-02	1.47E-02	2.64E-02
delta-BHC	54	1.00E-03	3.80E+00	8.55E-02	2.15E-01
Dieldrin		1.00E-03	4,50E-01	3.86E-02	6.62E-02
Endosulfan I	50	1.00E-03	8,40E-02	5,22E-03	9.44E-03
Endrin	50	4.00E-03	8,40E-02 8,20E+00	3.62E+00	5.74E+00
gamma-Chlordane	10		1.20E+00	1.41E-01	2.17E-01
Heptachlor epoxide	54	1.00E-03	5.40E-02	1.68E-02	7.85E-02
Chlorpyrifos	6	1.50E-04		7.00E-03	7.00E-03*
Glyphosate	6	7.00E-03	7.00E-03	1.50E-03	1.50E-03*
Oxadiazon	6	1.50E-03	1.50E-03		8.68E+01
Arsenic	119	2.03E+00	1.10E+03	6.55E+01	1.02E+02
Barium	13	3.50E+01	1.53E+02	8.32E+01	1910-01-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-
Cadmium	13	1.69E-01	1.30E+01	5.44E+00	8.19E+00
Chromium	13	2.97E+01	2.44E+02	1.22E+02	1.57E+02
Lead	59	1.12E+01	3.40E+03	3.62E+02	5.08E+02
Mercury	13	5.94E-01	4.00E+01	1.71E+01	3.41E+01
Selenium	13	6.57E-01	6.00E+00	2.43E+00	3.69E+00
Silver	13	2.22E-01	1.28E+00	7.24E-01	9.72E-01

<sup>\*</sup> Maximum detected value.

## 2. RISK-BASED CONCENTRATION CALCULATION METHODLOGY

The site-specific air RBCs were calculated following the methodology recommended by EPA Region 3 in their RBC table (EPA, 2006). A target cancer risk (TR) of 1E-06 (also termed one in a million) was used for contaminants known or suspected to be

carcinogens. A target hazard quotient (THQ) of 1 was used for noncancer effects. Table 2-1 shows the algorithm used for calculating the RBCs for the residents. RBCs were estimated for both a child and adult resident.

Table 2-1 Risk-Based Calculation Methodology

Cancer-B	ased	RBC TD V RW V AT
		$RBC (\mu g/m^3) = \frac{TR \times BW \times AT}{IRA \times EF \times ED \times CSF \times CF}$
Noncanc	er-B	ased RBC $RBC (\mu g/m^3) = \frac{THQ \times BW \times AT}{IRA \times EF \times ED \times 1/RfD \times CF}$
Where:		
TR	=	Target cancer risk level (1E-06).
THQ	=	Target hazard quotient (1.0).
BW	=	Body weight: Child – 15 kg (EPA, 1991) Adult – 70 kg (EPA, 1991)
AT	=	Averaging time:  Cancer-based – 25,550 days (based on 70 year lifetime) (EPA, 1989)  Noncancer-based – 90 days (based on 3 month duration of exposure) (EPA, 1989)
IRA	=	Inhalation rate:  Child – 12 m³/day (EPA, 2006)  Adult – 20 m³/day (EPA, 2006)
EF	=	Exposure frequency: 90 days/year, duration of excavation activities is assumed to be 3 months.
ED	=	Exposure duration: 0.25 year, duration of excavation activities is assumed to be 3 months.
CSFi	=	Inhalation cancer slope factor (mg/kg-day) <sup>-1</sup> : see Table 2-2.
RfDi	=	Inhalation reference dose (mg/kg-day): see Table 2-2.
CF	=	Units conversion factor: 0.001 mg/µg.

The child and adult body weights are 15 kg and 70 kg, respectively. These are default values recommended by EPA (EPA, 1991). It is conservatively assumed that the duration of the excavation activities and thereby the duration of potential inhalation exposure is 3 months (90 days per year). The total potential duration of the inhalation exposure is 0.25 years (3 months divided by 12 months). The averaging time for cancer effects is based on a 70-year lifetime and equates to 25,550 days (70 years X 365 days/year) (EPA, 1989). The noncancer averaging time is equal to the exposure duration multiplied by 365 days/year. The child and adult are assumed to inhale 12 m³ and 20 m³ of air on a daily basis (EPA, 2006). The inhalation cancer slope factors (CSFs), which are used to estimate the cancer-based RBCs, and the inhalation reference doses (RfDs), which are used to estimate the noncancer-based RBCs, are presented on Table 2-2.

Table 2-2
Toxicity Criteria

	Inhalation Cancer Slope Factor	Inhalation Reference Dose
Contaminant	(mg/kg-day) <sup>-1</sup>	(mg/kg-day)
4,4' -DDD	2.40E-01 a	NA
4,4' -DDE	3.40E-01 <sup>a</sup>	NA
4,4' -DDT	3.40E-01	5.00E-04 a
Aldrin	1.72E+01	3.00E-05 a
alpha-BHC	6.30E+00	NA
apha-Chlordane	3.50E-01	2.00E-04
Chlordane (tech)	3.50E-01	2.00E-04
delta-BHC	6.30E+00 <sup>b</sup>	NA
Dieldrin	1.61E+01	5.00E-05 a
Endosulfan I	NA	6.00E-03 a,c
Endrin	NA	3.00E-04 a
gamma-Chlordane	3.50E-01	2.00E-04
Heptachlor epoxide	9.10E+00	1.30E-05 a
Chlorpyrifos	NA	3.00E-03 a
Glyphosate	NA	1.00E-01 a
Oxadiazon	ŇÁ	5,00E-03 a
Arsenic	1.51E+01	3.00E-04 <sup>a</sup>

Table 2-2 (continued)
Toxicity Criteria

	Inhalation Cancer Slope Factor	Inhalation Reference Dose	
Contaminant	(mg/kg-day) <sup>-1</sup>	(mg/kg-day)	
Barium	NA	1.40E-04 <sup>d</sup>	
Cadmium	6.30E+00	5.70E-05°	
Chromium	NA	1.50E+00 a,f	
Lead	NA	NA	
Mercury	NA	8.57E-05	
Selenium	NA	5.00E-03 <sup>a</sup>	
Silver	NA	5.00E-03 a	

#### Notes:

NA = Not available.

The cancer potency of a contaminant is directly proportional to the CSF value; the higher the CSF, the more potent the contaminant as a carcinogen. Noncarcinogens refer to contaminants that cause toxic effects other than cancer. Noncancer effects can include, for example, central nervous system damage, reproductive effects, and other systemic effects. The premise of a reference dose is that there is an exposure level below which deleterious noncancer effects are not expected to occur. Reference doses are inversely proportional to the toxic potency of a contaminant, in other words, the lower the RfD, the more potent the contaminant. Unless noted otherwise, the inhalation cancer slope factors and reference doses were obtained from EPA's Integrated Risk Information System (IRIS) (EPA, 2007). In cases where a contaminant does not have an inhalation CSF or RfD but does have an oral CSF or RfD, the available oral value was used as a provisional value to estimate the inhalation exposure route. The use of the toxicity value developed for one exposure route to evaluate the toxicity from another is known as route-to-route

<sup>&</sup>lt;sup>a</sup> Oral values was extrapolated to the inhalation route.

<sup>&</sup>lt;sup>b</sup> delta-BHC value used as a surrogate.

<sup>&</sup>lt;sup>c</sup> Endosulfan value used as a surrogate.

<sup>&</sup>lt;sup>d</sup> Value taken from the Health Effects Assessment Summary Table.

<sup>&</sup>lt;sup>e</sup> Value taken from the National Center for Environmental Assessment as presented on the EPA Region 3 RBC Table (EPA, 2006).

<sup>&</sup>lt;sup>f</sup> Chromium III value assumed for all chromium in soil. Hexavalent chromium considered unlikely contributor (ATSDR, 2000).

extrapolation. No adjustments were made to the toxicity values when using route-toroute extrapolation (i.e., the same value was used for both routes). This adds uncertainty to the derived provisional values by not accounting for route-specific differences in contaminant absorption, metabolism, and potential target tissues.

Table 2-3 summarizes the calculated RBCs. As presented on the table, cancer- and noncancer-based RBCs were calculated for the child and adult.

Table 2-3

Calculated RBCs (μg/	Child		A		
	Cancer-Based	Noncancer-Based	Cancer-Based	Noncancer-Based	Lowest RBC
Contaminant		NA	1.66E+01	. NA	4.73E+00
4,4' -DDD	4.73E+00	NA	1.17E+01	NA	3.34E+00
4,4' -DDE	3.34E+00		1.17E+01	7.08E+00	2.02E+00
4,4' -DDT	3.34E+00	2.02E+00		4.25E-01	6.62E-02
Aldrin	6.62E-02	1.21E-01	2.32E-01	NA	1.80E-01
alpha-BHC	1.80E-01	NA	6.31E-01		8.09E-01
	3.24E+00	8.09E-01	1.14E+01	2.83E+00	8.09E-01
apha-Chlordane	3.24E+00	8.09E-01	1.14E+01	2.83E+00	
Chlordane (tech)	1,80E-01	NA	6.31E-01	NA	1.80E-01
delta-BHC		2.02E-01	2,47E-01	7.08E-01	7.05E-02
Dieldrin	7.05E-02		NA	8.49E+01	2.43E+01
Endosulfan I	NA	2.43E+01	NA	4.25E+00	1.21E+00
Endrin	NA	1.21E+00		2.83E+00	8.09E-01
gamma- Chlordane	3.24E+00	8.09E-01	1.14E+01	1,84E-01	5.26E-02
Heptachlor epoxide	1.25E-01	5.26E-02	4.37E-01	100 2500 000	1.21E+01
	NA	1.21E+01	NA	4.25E+01	4.04E+02
Chlorpyrifos	NA	4.04E+02	NA	1.42E+03	
Glyphosate	NA NA	2.02E+01	NA	7.08E+01	2.02E+01
Oxadiazon		1.21E+00	2.64E-01	4.25E+00	7.55E-02
Arsenic	7.55E-02		NA	1.98E+00	5.66E-01
Barium	NA	5.66E-01	6.31E-01	8.07E-01	1.80E-01
Cadmium	1.80E-01	2.31E-01		2.12E+04	6.07E+03
Chromium	NA	6.07E+03	NA		1.50E+00
Lead	NA	NA	NA	NA	1.5025.00

Table 2-3, continued Calculated RBCs (μg/m³)

(m°)	Child	Adult			
Cancer-Based	Noncancer-Based	Cancer-Based	Noncancer-Based	Lowest RBC	
NA	3.47E-01	NA	1.21E+00	3.47E-01	
	2.02E+01	NA	7.08E+01	2.02E+01	
-	2.02E+01	NA	7.08E+01	2.02E+01	
	(	Cancer-Based Noncancer-Based  NA 3.47E-01  NA 2.02E+01	Cancer-Based Noncancer-Based Cancer-Based  NA 3.47E-01 NA  NA 2.02E+01 NA	Cancer-Based Noncancer-Based Cancer-Based Noncancer-Based  NA 3.47E-01 NA 1.21E+00  NA 2.02E+01 NA 7.08E+01	

NA = Not available.

### 3. PM<sub>10</sub> ACTION LEVEL CALCULATION METHODOLOGY

The risk-based  $PM_{10}$  Action Levels were calculated based on the site-specific RBCs presented on Table 2-3 and the 95% UCLs in soil presented on Table 1-1. It was assumed that the levels measured in the soil were the same as the levels to be measured by the  $PM_{10}$  samplers and therefore available for inhalation by the residents. Table 3-1 presents the procedure followed to relate the conservatively calculated air RBC and the 95% UCL to a target risk-based  $PM_{10}$  Action Level concentration.

Table 3-1
Target PM<sub>10</sub> Calculation Methodology

Target PIM <sub>10</sub> Calculation Methodology					
Target PM <sub>10</sub> Concentration ( $\mu$ g/m <sup>3</sup> ) = $\frac{RBC}{CS \times CF}$					
Where	:				
RBC	=	Most stringent risk-based concentration (µg/m³): see Table 2-3.			
CS	=	Concentration of the contaminant in soil represented by the 95% upper-confidence limit of the mean (mg/kg): see Table 1-1.			
CF	=	Units conversion factor; 0.000001 kg/mg.			

Table 3-2 presents the calculated contaminant-specific target PM<sub>10</sub> concentrations.

<sup>\*</sup> National Ambient Air Quality Standard.

Table 3-2 Target PM<sub>10</sub> Concentrations ( $\mu g/m^3$ )

	RBC	CS	Target PM <sub>10</sub> Concentration
Analyte	(μg/m³)	(mg/kg)	(μg/m <sup>3</sup> )
4,4' -DDD	4.73E+00	6.95E-02	6.81E+07
4,4' -DDE	3,34E+00	4.85E-01	6.89E+06
4,4' -DDT	2.02E+00	2.60E-01	7.78E+06
Aldrin	6.62E-02	4.00E-02	1.66E+06
alpha-BHC	1.80E-01	3.66E-02	4.92E+06
apha-Chlordane	8.09E-01	1.18E+01	6.88E+04
Chlordane (tech)	8.09E-01	2.90E+01	2.79E+04
delta-BHC	1.80E-01	2.64E-02	6.82E+06
Dieldrin	7.05E-02	2,15E-01	3.28E+05
Endosulfan I	2.43E+01	6.62E-02	3.67E+08
Endrin	1.21E+00	9.44E-03	1.29E+08
gamma- Chlordane	8.09E-01	5.74E+00	1.41E+05
Heptachlor epoxide	5.26E-02	2.17E-01	2.42E+05
Chlorpyrifos	1.21E+01	7.85E-02	1.55E+08
Glyphosate	4.04E+02	7.00E-03*	5.78E+10
Oxadiazon	2.02E+01	1.50E-03*	1.35E+10
Arsenic	7.55E-02	8.68E+01	8.70E+02
Barium	5.66E-01	1.02E+02	5.56E+03
Cadmium	1.80E-01	8.19E+00	2.20E+04
Chromium	6.07E+03	1.57E+02	3.87E+07
Lead	1.50E+00**	5.08E+02	2.96E+03
Mercury	3.47E-01	3.41E+01	1.02E+04
Selenium	2.02E+01	3.69E+00	5.48E+06
Silver	2.02E+01	9.72E-01	2.08E+07

#### Notes:

As presented on Table 3-2, arsenic resulted in the most stringent  $PM_{10}$  Action Level. Therefore, the measured  $PM_{10}$  concentrations can be compared to the arsenic Action

<sup>\*</sup> Based on maximum detected concentration.

<sup>\*\*</sup> RBC for lead is equal to the National Ambient Air Quality Standard.

Level. If the PM<sub>10</sub> concentrations are less than the arsenic Action Level, they would also be less than the Action Levels for the other contaminants.

#### 4. REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Chromium. U.S. Department of Health and Human Services.

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Date	Time	Meter Location	Weather	Instantaneous	itaneous Average Maxin	mnu	PID Reading (ppm)	Notes (potential source of dust, wind direction, observations, etc.)	Actions Taken	nital Sustain
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				>						
		22								
VOCs = 5 nnm	Monitoring A	ction Levels:	Perimeter Monitoring Action Levels: NR: No readings collected NOCs = 5 nnm	NR: No readings collected		Actions:				
PM10 = 0.	PM10 = 0.150 mg/m3		IV. IVOL applic	able due to wealth		uspena excav	Suspend excavation activities until cond	Suspend excavation activities until concentrations drop below action levels.		
Field Actio	Field Action Level = 0.050 mg/m3	350 mg/m3					מה וכא ווכוסססולו	-1001		



## ATTACHMENT B Perimeter Air Monitoring Log